

CLAIM AMENDMENTS

Claims 1 through 10 (canceled)

11. (New) A method for coproducing methanol and ammonia from natural gas, which comprises the steps of:

(a) mixing natural gas, steam and oxygen which has a purity of 90 to 99.5% in a catalytic partial oxidation reactor in the presence of a catalyst for reforming natural gas to partially oxidize and reform the natural gas into a gas mixture which comprises carbon monoxide, carbon dioxide, hydrogen and steam;

(b) dividing the gas mixture obtained in step (a) into two portions, a larger portion for hydrogen production and a smaller portion for methanol synthesis;

c) catalytically converting the carbon monoxide in the larger portion of the gas mixture for hydrogen production to carbon dioxide to obtain a gas mixture rich in hydrogen and carbon dioxide in a one or two stage catalytic converter, and cooling the gas mixture rich in hydrogen and carbon dioxide this produced;

(d) passing the gas mixture rich in hydrogen and carbon dioxide to a purification unit having a molecular sieve and maintained at a pressure of 30 to 100 bar, passing the gas mixture

19 rich in hydrogen and carbon dioxide through the molecular sieve  
20 using variable pressure absorption, to separate the carbon dioxide  
21 from the hydrogen, splitting the hydrogen into two streams,  
22 combining one stream of hydrogen with the smaller portion of the  
23 gas mixture obtained in step (b) for synthesis of methanol, and  
24 subsequently washing out any residual impurities from the other  
25 stream of hydrogen, including methane, carbon monoxide, and argon,  
26 with a stream of liquid nitrogen to obtain a pure stream of  
27 hydrogen and nitrogen for ammonia synthesis, and returning the  
28 washed out residual impurities as a fuel to the catalytic partial  
29 oxidation reactor according to step (a);

30 (e) catalytically converting the smaller portion of the  
31 gas mixture obtained in step (b) combined with the stream of  
32 hydrogen according to step (d) to methanol, and purifying the  
33 methanol by distilling the methanol at a pressure between  
34 atmospheric pressure and 15 bar; and

35 (f) catalytically converting the pure stream of  
36 hydrogen and nitrogen obtained according to step (d) to ammonia,  
37 and separating the ammonia by means of partial condensation.

1           12. (New) The process defined in claim 11, wherein  
2     according to step (a) a part of the natural gas is first fed  
3     through a steam reformer, in which at a temperature between 700 and  
4     950°C, in a molar ratio of steam to carbon between 1.5 and 3.0, and  
5     at a pressure between 25 and 50 bar, the natural gas is  
6     catalytically converted to synthesis gas, and the synthesis gas is  
7     subsequently mixed with additional natural gas and fed into the  
8     catalytic partial oxidation reactor.

1           13. (New) A method for coproducing methanol and  
2     ammonia from natural gas, which comprises the steps of:

3           (a) mixing natural gas, steam and oxygen which has a  
4     purity of 90 to 99.5% in a catalytic partial oxidation reactor in  
5     the presence of a catalyst for reforming natural gas to partially  
6     oxidize and reform the natural gas into a gas mixture which  
7     comprises carbon monoxide, carbon dioxide, hydrogen and steam;

8           (b) dividing the gas mixture obtained in step (a) into  
9     two portions, a larger portion for hydrogen production and a  
10    smaller portion for methanol synthesis;

11 (c) catalytically converting the carbon monoxide in the  
12 larger portion of the gas mixture for hydrogen production to carbon  
13 dioxide to obtain a gas mixture rich in hydrogen and carbon dioxide  
14 in a one or two stage catalytic converter, and cooling the gas  
15 mixture rich in hydrogen and carbon dioxide this produced;

16 (d) passing the gas mixture rich in hydrogen and carbon  
17 dioxide to a carbon dioxide absorption column, and the carbon  
18 dioxide is washed out of the gas mixture to yield a gas mixture  
19 rich in hydrogen;

20 (e) passing the gas mixture rich in hydrogen to a  
21 purification unit having a molecular sieve and maintained at a  
22 pressure of 30 to 100 bar, splitting the hydrogen into two streams  
23 combining one stream of hydrogen with the smaller portion of the  
24 gas mixture obtained in step (b) for synthesis of methanol, and  
25 subsequently washing out any residual impurities from the other  
26 stream of hydrogen, including methane, carbon monoxide, and argon,  
27 with a stream of liquid nitrogen, to obtain a pure stream of  
28 hydrogen and nitrogen for ammonia synthesis and returning the  
29 washed out residual impurities as a fuel to the catalytic partial  
30 oxidation reactor according to step (a);

31 (f) catalytically converting the smaller portion of the  
32 gas mixture obtained in step (b) combined with the stream of  
33 hydrogen according to step (e) to methanol , and purifying the  
34 methanol by distilling the methanol at a pressure between  
35 atmospheric pressure and 15 bar; and

36 (g) catalytically converting the pure stream of  
37 hydrogen and nitrogen obtained according to step (e) to ammonia,  
38 and separating the ammonia by means of partial condensation.

1 14. (New) The process defined in claim 13, wherein  
2 according to step (a) a part of the natural gas is first fed  
3 through a steam reformer, in which at a temperature between 700 and  
4 950°C, in a molar ratio of steam to carbon between 1.5 and 3.0, and  
5 at a pressure between 25 and 50 bar, the natural gas is  
6 catalytically converted to synthesis gas, and the synthesis gas is  
7 subsequently mixed with additional natural gas and fed into the  
8 catalytic partial oxidation reactor.

1 15. (New) The process defined in claim 13, wherein  
2 according to step (d), the gas mixture rich in hydrogen and carbon  
3 dioxide is compressed to aid in removing carbon dioxide from the  
4 gas mixture.

1           16. (New) The process defined in claim 15, wherein the  
2 gas mixture rich in hydrogen and carbon dioxide is washed with the  
3 help of a physical absorbent.

1           17. (New) The process defined in claim 16 wherein the  
2 physical absorbent is selected from the group consisting of cold  
3 methanol and glycolether.

1           18. (New) The process defined in claim 15, wherein the  
2 gas mixture rich in hydrogen and carbon dioxide is washed with the  
3 help of a chemical absorbent.

1           19. (New) The process defined in claim 18 wherein the  
2 chemical absorbent is selected from the group consisting of an  
3 alkanolamine, a polyalkanolamine, and potassium carbonate.

1           20. (New) The process defined in claim 13, wherein  
2 according to step (d) the carbon dioxide washed out of the gas  
3 mixture is used for urea manufacture.

1           21. (New)     A method for coproducing methanol and  
2 ammonia from natural gas, which comprises the steps of:

3           (a) mixing natural gas, steam and oxygen which has a  
4 purity of 90 to 99.5% in a catalytic partial oxidation reactor in  
5 the presence of a catalyst for reforming natural gas to partially  
6 oxidize and reform the natural gas into a gas mixture which  
7 comprises carbon monoxide, carbon dioxide, hydrogen and steam;

8           (b) dividing the gas mixture obtained in step (a) into  
9 two portions, a larger portion for hydrogen production and a  
10 smaller portion for methanol synthesis;

11           (c) catalytically converting the carbon monoxide in the  
12 larger portion of the gas mixture for hydrogen production to carbon  
13 dioxide to obtain a gas mixture rich in hydrogen and carbon dioxide  
14 in a one or two stage catalytic converter, and cooling the gas  
15 mixture rich in hydrogen and carbon dioxide this produced;

16           (d) passing the gas mixture rich in hydrogen and carbon  
17 dioxide to a carbon dioxide absorption column, washing out the  
18 carbon dioxide of the gas mixture to yield a gas mixture rich in  
19 hydrogen, splitting the hydrogen into two streams combining one  
20 stream of hydrogen with the smaller portion of the gas mixture  
21 obtained in step (b) for synthesis of methanol, and introducing  
22 the other stream of hydrogen into a purification unit having a

23 molecular sieve and maintained at a pressure of 30 to 100 bar for  
24 subsequent ammonia synthesis;

25 (e) further introducing into the purification unit, a  
26 stream of liquid nitrogen for washing out any residual impurities  
27 from the other stream of hydrogen, including methane, carbon  
28 monoxide, and argon, to obtain a pure stream of hydrogen and  
29 nitrogen for ammonia synthesis and returning the washed out  
30 residual impurities as a fuel to the catalytic partial oxidation  
31 reactor according to step (a);

32 (f) catalytically converting the smaller portion of the  
33 gas mixture obtained in step (b) combined with the stream of  
34 hydrogen according to step (d) to methanol, and purifying the  
35 methanol by distilling the methanol at a pressure between  
36 atmospheric pressure and 15 bar; and

37 (g) catalytically converting the pure stream of  
38 hydrogen and nitrogen obtained according to step (e) to ammonia,  
39 and separating the ammonia by means of partial condensation.



1           22. (New) The process defined in claim 21, wherein  
2 according to step (a) a part of the natural gas is first fed  
3 through a steam reformer, in which at a temperature between 700 and  
4 950°C, in a molar ratio of steam to carbon between 1.5 and 3.0, and  
5 at a pressure between 25 and 50 bar, the natural gas is  
6 catalytically converted to synthesis gas, and the synthesis gas is  
7 subsequently mixed with additional natural gas and fed into the  
8 catalytic partial oxidation reactor.

1           23. (New) The process defined in claim 21, wherein  
2 according to step (d), the gas mixture rich in hydrogen and carbon  
3 dioxide is compressed to aid in removing carbon dioxide from the  
4 gas mixture.

1           24. (New) The process defined in claim 23, wherein the  
2 gas mixture rich in hydrogen and carbon dioxide is washed with the  
3 help of a physical absorbent.

1           25. (New) The process defined in claim 24 wherein the  
2 physical absorbent is selected from the group consisting of cold  
3 methanol and glycolether.

1           26. (New) The process defined in claim 21, wherein  
2     according to step (d) the gas mixture rich in hydrogen and carbon  
3     dioxide is washed with the help of a chemical absorbent.

1           27. (New) The process defined in claim 26 wherein the  
2     chemical absorbent is selected from the group consisting of an  
3     alkanolamine, a polyalkanolamine, and potassium carbonate.

1           28. (New) The process defined in claim 21, wherein  
2     according to step (d) the carbon dioxide washed out of the gas  
3     mixture is used for urea manufacture.